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TRB Forum on Preparing for Automated Vehicles and Shared Mobility

Mini-Workshop on the Transition Toward Shared Automated Vehicles

February 13, 2019
Washington, D.C.

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Preface

The deployment of automated vehicles, shared mobility services, and other transformational transportation technologies has the potential to dramatically increase safety, reduce congestion, improve access, enhance sustainability, and spur economic development. However, success in meeting these goals is not assured and there are significant risks that these deployments could cause unintended consequences.

The National Academies–TRB Forum on Preparing for Automated Vehicles and Shared Mobility was officially launched in early 2018 to facilitate evidence-based research needed to deploy these technologies in a manner and a timeframe that informs policy to meet these long-term goals. The Forum has held five meetings since then, promoting discussion among its members and the public, creating white papers, developing research priority lists, and engaging in workshops dedicated to specific questions around automated vehicles and shared mobility. This paper was developed as a summary of one such workshop held by this Forum. Tim Papandreou and Katherine Kortum authored the paper. Susan Shaheen and Steve Shladover of the University of California, Berkeley, and Carol Schweiger of Schweiger Consulting reviewed the paper.

PUBLISHER'S NOTE

ACKNOWLEDGMENTS

A small volunteer group of Forum members and TRB staff planned and organized the mini-workshop described in this report. Members of this working group were

- Tim Papandreou, Emerging Transport Advisors (co-chair);
- Susan Shaheen, UC Berkeley (co-chair);
- Jean Crowther, Alta Planning and Design;
- George Ivanov, Waymo;
- Greg Krueger, TRB Standing Committee on ITS;
- Carol Schweiger, TRB Standing Committee on Emerging and Innovative Public Transportation Technology;
- Steven Shladover, TRB Vehicle-Highway Automation Committee;
- Bernard Soriano, California DMV; and
- Prachi Vakharia, Steer.

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Introduction

In order to better inform all Forum members and generate discussion on strategic crosscutting issues, members are holding a series of mini-workshops in 2019. These mini-workshops focus on answering three main questions: 1) why the subject area is of critical importance; 2) what the current state of play is; and 3) what the future might hold. The Transition Toward Shared and Automated Vehicles Mini-Workshop occurred on February 13, 2019 in Washington, D.C. This report contains a summary of the mini-workshop, including key takeaways, panelist remarks, summaries of breakout group discussions, and a set of proposed research questions.

Workshop Format and Agenda

The workshop began with remarks by Tim Papandreou, who reminded participants that there are still a wide variety of questions about automated vehicles (AVs) and shared and automated vehicles (SAVs), and how they will affect the future. After his opening statements, the group separated into three breakout groups, each of which focused on a particular SAV theme: regulation, equity, and streets and land use. After the breakout discussions, the groups reconvened with breakout summary reports and closing remarks. A key outcome of the workshop was the identification of specific research questions.

Key Takeaways

Trends in transportation and digital transformation are upending our traditional notion of transportation and bringing unprecedented opportunities and challenges. This shift will not happen all at once. It is clear it will be a transition. This transition will have visibly different geospatial and temporal effects depending on the physical, political, and social situation of each region.

The mini-workshop identified what research is needed to transition to the vision (emphasizing the transition itself and need for immediate actions to facilitate the transition in the short term). Key research questions identified for regulation, equity, and land use and streets are listed below.

Opening Session

Timothy Papandreou opened the mini-workshop and shared mega trends around:

- Transportation issues requiring a change from business as usual—rapid urbanization, safety, demographics, emissions, access, congestion, and efficiency.
- Digital transformation trends: e-commerce digitization, platforms, and connected devices, shared mobility scaling, and mobility as a service/mobility on demand.

These trends are upending our traditional notion of transportation and bringing unprecedented opportunities and challenges to travel modes, urban form and land use, propulsion, employment, safety, data management, and ultimately governance. This shift will not happen all at once, and it is clear it will be a transition—one that will have visibly different geo-spatial and temporal effects depending on the physical, political, and social situation of each urban region.

This Forum focuses on sharing specifically in the context of SAVs, which includes passenger, delivery/commercial and municipal services, shared fleets, and shared rides (sequential and concurrent sharing), along with ground, sea, and air systems.

Data technology companies are dominating market share of traditional industries with a platform approach. By linking producers of services with customers who purchase those services, the data transaction exchange creates value for the company, producer, and customer; it can scale to all parts of the economy.

The key question raised was how to bring governance into the era of digitization, so they are able to manage demand and supply digitally. At the same time, it is necessary to correct for the existing inequities in our system, working closer with public and private sector partners, and developing the infrastructure needed to ensure that the transition to SAVs minimizes the potential challenges and takes advantage of those opportunities that may come out of this transportation transformation.

This transition and its effects will not happen tomorrow, and there are several unknowns. The purpose of the forum is to map out what is known, what is not known, and what needs and what people want to happen to get to the point where SAVs are on the roads and providing overall benefits to society.

Breakout Summaries

REGULATION

This breakout session addressed safety readiness, vulnerable road users, public acceptance, rights-of-way (ROWs) access and pricing, Mobility as a Service (MaaS)/Mobility on Demand (MOD), interoperability, curb management, and mixed fleets.

Figure 1 below depicts the direct impacts of various SAV factors on safety and vice versa. Since safety is the realm within which regulations are being developed, the figure could be used as a framework within which SAV research is conducted.

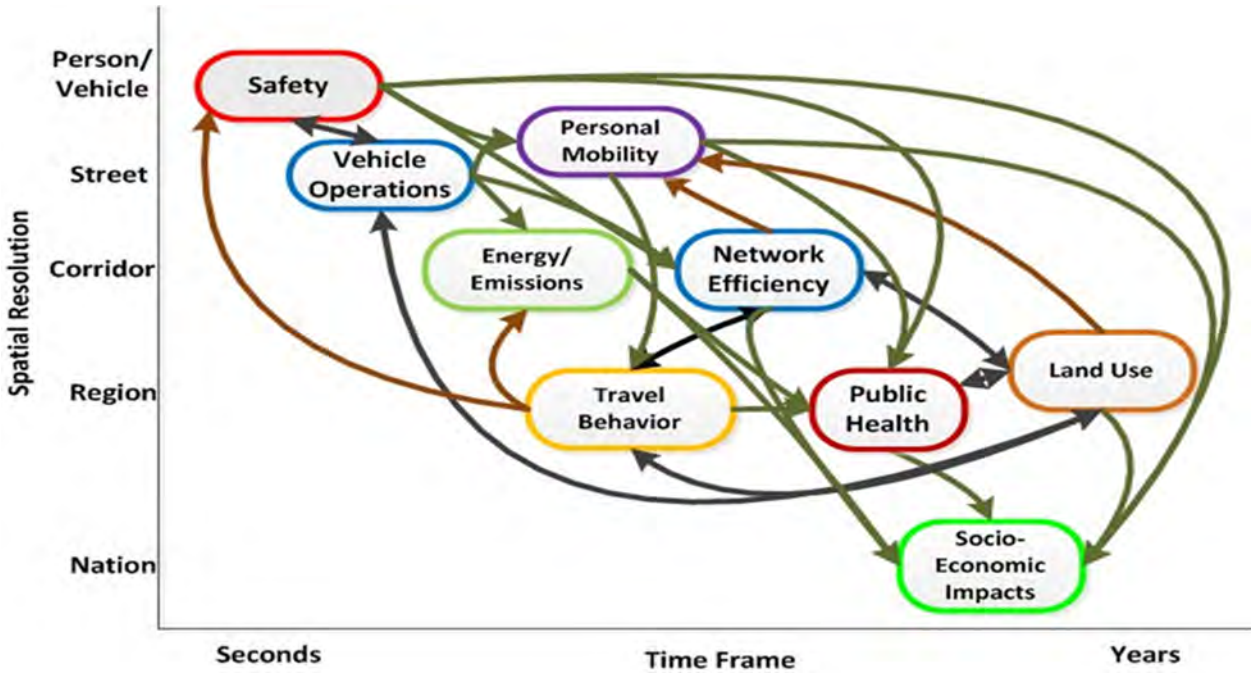

FIGURE 1 Impacts of various SAV factors on safety and vice versa.
(Source: Smith, Scott, Jonathan Koopmann, Hannah Rakoff, Sean Peirce, George Noel, Andrew Eilbert, and Mikio Yanagisawa. "Benefits Estimation Model for Automated Vehicle Operations: Phase 2 Final Report," January 1, 2018. https://rosap.ntl.bts.gov/view/dot/34458.)

Potential research topics include developing a better understanding of the degree to which public acceptance of SAVs is impacted by perceptions of SAV safety. The public's adoption and acceptance of SAVs has implications for establishing regulations around their ownership and use.

Another research topic is understanding the balance between overall safety outcomes for vehicles versus prescriptive regulations that attempt to cover every possible dimension of safety. Naturally, a patchwork of regulations would be difficult for original equipment manufacturers to accommodate. While states are looking to the federal government to set regulations on the vehicle side, some are moving ahead in the absence of these regulations in order to provide some degree of safety protection for their road users. This research would involve the assessment of well-controlled SAV pilot demonstrations to develop a framework for safety and other regulations at the state and local level. The research would include assessing the ability of public agencies to digest and use data and information resulting from the SAV demonstrations.

Current U.S. Department of Transportation (DOT) standards research efforts in the SAV area, including the MOD Multimodal and Accessible Travel Standards Assessment (MATSA), could be identified and reviewed to ensure that future research does not duplicate any of these existing efforts. The current research being conducted by the U.S. DOT MOD Sandbox, Accessible Transportation Technologies Research Initiative (ATTRI), and the Federal Transit Administration's Strategic Transit Automation Research (STAR) programs, along with consultant-led MOD efforts, will have an impact on SAV standards development in the future and should ideally be evaluated in developing SAV regulations. For example, how will public transit agencies comply with the Americans with Disabilities Act (ADA) in an automated world (e.g., assisting a wheelchair passenger to board or alight a vehicle and perform a wheelchair tie down)?

While it is unlikely that SAV impacts on public health will directly affect SAV standards or regulation development, research is needed to better understand the influences of SAVs on travel behavior, inclusivity/accessibility, equity, congestion, and their impacts on policy development.

Scenario analyses, such as those that depict mixed fleets (SAVs and nonautomated vehicles, both shared and privately owned), are needed to ensure that safety regulations consider a range of possible situations. Further, research should consider safety "tipping points" related to different penetration levels of SAVs in different scenarios.

EQUITY

The equity breakout session discussed accessibility and inclusivity across all incomes, races, ages, and abilities in relation to physical ROWs, service usability, and digital platforms; the role of policy and regulation; and measuring outcomes.

The group chose to broadly define equity as equal access for all people. In the context of the TRB Forum's focus on automated vehicles and shared mobility, there is the potential that certain groups might see little to no benefits from new mobility options but bear a disproportionate amount of the negative impacts (e.g., higher costs or increased congestion or reduced access). Additionally it is not known yet how to judge the implications of new technologies, services, and modes on a community at-large or on specific groups within communities. The group recognized the potential for unintended consequences and the importance of identifying analysis, evaluation methods and consistent tracking, and monitoring of outcomes.

Roles of public-sector agencies and private-sector providers have changed dramatically. Equity is generally an outcome of public-sector investment, ownership, or oversight rather than market forces. Some group members identified a need to newly define and affirm the role of government. A study to document and characterize the recent shifts in the role of government, as well as the relevant policy levers that exist, could help to inform public-private sector coordination, management of SAV services, and policy or regulatory approaches moving forward.

Equitable access to digital platforms also applies to usability, including persons with sight or hearing impairments that may have limitations in terms of how the vehicles communicate with them as a user. Research should consider possible SAV implications including transportation cost and travel time, the health of disparate populations, and public transit service.

STREETS AND LAND USE

This breakout group considered multimodal street design, parking impacts, electric charging, curb pick-up/drop-offs (PUDOs), connectivity, and support infrastructure.

Many state and local agencies have adopted complete streets principles, but they will need to rethink these to incorporate new technologies and, when appropriate, adopt a network rather than a corridor focus. For example, many cities are struggling with how to address electric scooters. The key consideration is how to promote safety in infrastructure design, but economic

analyses will also be needed to evaluate the market value of curb space (e.g., travel lane, parking, pick-up/drop-off) and the value of ROW elements (e.g., dedicated AV lanes, sidewalks). The roles of state and city DOTs and landowners will also need to be explored, and the successes of many access management programs may provide useful analogues. It is important to note that the transitional phase will continue as new travel modes and technologies continue to develop and evolve.

Many cities and airports have been experimenting with the design of pick-up/drop-off areas for SAVs and compiling best practices will be valuable. In addition to physical design, this review should include times of day and fee structures. This effort should build upon work underway by National Association of City Transportation Officials (NACTO) and the Institute of Transportation Engineers (ITE) should consider freight/delivery implications.

Many agencies have adopted Toward Zero Deaths initiatives, and SAVs are expected to contribute to these goals. Agencies need robust approaches to evaluate SAV safety impacts and related design and land-use treatments. Traditional methods rely on several years of crash data, but the rapid deployment of these modes and treatments make that problematic. New data sources (e.g., vehicle-to-everything, autos, roadside cameras, and onboard cameras) should be considered as well as the limitations of those data (e.g., privacy, ownership). Making data from these sources more widely available is also important, and experiences of sharing sensitive data in the medical industry may be useful. Surrogate safety assessment methods that do not rely on crash data should also be explored (e.g., conflict analysis, simulation).

SAVs (and electrification) will affect traditional funding sources for state and local DOTs (e.g., gas tax, parking revenue, enforcement fines). Alternative revenue sources (e.g., curbside fees, congestion–cordon pricing, tolls, zero-occupancy vehicle tolling) should also be explored. It is important to understand how these alternative sources influence desirable and undesirable traveler behaviors (e.g., zero-occupant vehicle cruising). In addition to offsetting losses in traditional sources, these new revenues could be used to upgrade and maintain equipment needed to support SAV services.

Many agencies are being encouraged to support the telecommunications industry small cell network efforts. A synthesis of these deployments that includes policy impacts would be useful to many public agencies. This research should also include an economic evaluation of publicly owned communication networks and vertical infrastructure (light poles and traffic signal support poles) used for mounting antennae.

Planners seek information on how to best incorporate SAVs into their planning efforts. Information on desired outcomes and system performance metrics (e.g., safety, vehicle miles traveled, congestion, productivity, environmental, economic, freight fluidity) would be very useful. Generalizable planning scenarios could be helpful in comparing and contrasting different areas and approaches. There is a need is to lessen undesirable effects, such as zero-occupancy vehicles cruising rather than parking. This research should examine leading indicators for desirable and undesirable outcomes. The rate of deployment and evolution may also warrant reconsideration of planning horizons and schedule revisions.

Traditional mode choice models have focused on the private vehicle and public transit choices. As SAVs and other technologies are deployed, new approaches to helping travelers choose a mode and methods for analyzing choices are needed. Encouraging appropriate mode choices for different trip purposes should be considered, along with the value of travel time by different modes. Designs that facilitate seamless modal transfers should be evaluated. Public support and acceptance of the different modes should be evaluated, along with concerns

including concurrent sharing. The Partners for Automated Vehicle Education coalition, recently launched by SAE International, may be helpful.

Many automated driving applications under development try to predict behavior of users of the ROWs. Some of these users are hard to predict (e.g., pedestrians, bicyclists, e-scooter users) and encouraging more uniform or predictable behavior, in part by providing dedicated spaces within the ROW for different modes, would help to make AVs safer and more efficient. These vehicles will be operating in a mixed environment for the foreseeable future and land use and design treatments that improve predictable operation will be helpful.

The use of urban air mobility (UAM) in the public ROWs is expected to increase and government agencies will need to develop policies and regulations to address UAM. These policies should consider safety, noise, and emissions. Creation of UAM routes in a region also should be considered.

Electric vehicles are expected to become more common and transportation agencies are likely to be involved in the design and deployment of the charging system. Key system considerations include: charging standard (inductive versus plug-in), the location of charging facilities, implications of shared electric fleets (including ferries), and the roles of the private and public sector. Demands on the electric grid will also need to be considered.

One potential outcome of SAVs could be reduced need for parking facilities. Methods of repurposing facilities should be explored under a range of market penetration scenarios. This should build upon efforts by the Urban Land Institute.

The Uniform Vehicle Code should be reviewed and needed changes identified.

Key Research Questions

This section includes research questions for the three breakout areas including: regulation, equity, and streets and land use.

REGULATION

What are the potential impacts of SAVs and their regulations on overall safety and public health? What are the opportunities and barriers to SAV adoption and acceptance by the public? What lessons are we learning along the way? These lessons have implications for establishing policy and regulations. In the next three years, it will be important to have objective assessment of user acceptance.

What level of government has responsibility for regulating the driving task? It is important to clarify the role of the federal government as compared to the states.

What are safety “tipping points” regarding market penetration levels of connected and automated vehicles? It is important to address different scenarios and circumstances for mixed fleets. All automated vehicles have the same safety potential, and immunity/vaccination models from the medical industry may prove to be a helpful starting point.

What are standard methodologies for state and local agencies to act on results from demonstrations and pilot projects? Agencies vary in their ability to digest and act upon data and information. A possible study focused on the United States could be modeled after the

Infrastructure Victoria report: “Advice on Automated and Zero Emissions Vehicle Infrastructure.”

EQUITY

Where are the gaps in public engagement and market research on AVs and SAVs? Most transportation users are not currently targets of private sector market research.

How do we ensure equitable access to digital platforms?

What are transportation cost and travel time implications of SAVs? In particular, what are the implications for health of disparate populations? The implications of SAVs on equity and public transit are also vital to understand, as transit is the current equity-provider within transportation.

STREETS AND LAND USE

How do complete streets need to be reconsidered at a network level for all users in light of AVs and SAVs? Research should assess the safety and economic effects, such as the value of the curb. It should also design for this SAV transitional period, drawing upon bus rapid transit and bike lane experience.

How should pick-up/drop-offs zones be managed? Waiting time and fees are two of many considerations. Best practices can look at airports as an example. Research should also build upon work by NACTO and ITE.

What are the data sources and limitations on streets and land use? Sources might include vehicle-to-infrastructure installations, automated vehicles, and municipal cameras, while limitations include privacy concerns and data ownership. Surrogate approaches to the actual data include conflicts, near crashes, and simulations. The medical industry could provide a useful model for management of sensitive personal data.

What are the impacts on pricing streets and land use on transportation funding? Electric vehicles and reduced parking requirements can lead to reduced funding, though improved management of curbsides can be an increase. Street management and funding should align with cities’ tolling, congestion pricing, and cordon efforts.

What methods should be employed to provide funds for installing, upgrading, and maintaining connected vehicle equipment? Note: deployment of small cell networks is a significant undertaking, though it is currently handled by private cellular operators.

How can we develop a synthesis of current practices as it relates to AVs and SAVs, and street and land use? Such a synthesis should evaluate policy impacts and provide an economic analysis of the U.S. DOT communication network and vertical infrastructure.

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